GKN Driveline International GmbH
Hauptstrasse 150
53797 Lohmar

28th May 2004
Ne/bec (20040226)
Q03022 Ausland

Axial setting device with disc spring transmission

Description

The invention relates to a coupling assembly having an axial setting device in the form of a ball ramp assembly with an axially supported supporting disc and an axially displaceable pressure disc which, in their end faces facing one another, are provided with ball grooves whose depth is circumferentially variable in opposite directions, wherein balls via which the supporting disc and the pressure disc axially support one another run in pairs of ball grooves and wherein the supporting disc and the pressure disc are rotatable relative to one another by being driven by a motor.

Coupling assemblies of this type are widely used in the drivelines of motor vehicles in the form of locking couplings for differential drives or in the form of so-called hang-on couplings for optionally driving an additional driving axle. However, their field of application is not limited to said ranges of use. As a rule, the electromotive drive of at least one of the discs rotatable relative to one another, i.e. the supporting disc and the pressure disc, is effected via a spur gear reduction stage, with a transmission ratio of 1: 50 being typical. This results in high axial loads on the axial bearings used for the support of, or pressure transmission to, the two discs. There are generated extremely high pressure loads on the few supporting balls in the pairs of ball grooves.

It is the object of the present invention to reduce the above-described high loads on the ball ramp assembly without having to accept a reduction in the axial setting forces at the coupling assembly. The objective is achieved in that the pressure disc of the ball ramp assembly acts on the first pressure plate and that the coupling assembly is loaded by a second pressure plate, wherein a disc spring is arranged between the first pressure plate and the second pressure plate, wherein the apex of the disc angle of the disc spring points towards the first pressure plate and which disc spring, at its outer circumference, is axially secured in the coupling carrier, acts on the second pressure plate by means of an intermediate diameter and, at its inner edge, rests against the first pressure plate.

In the present assembly in accordance with the invention a transmission reduction between the pressure disc and the coupling assembly is achieved via a disc spring which generates a lever effect. With reduced axial forces at the ball ramp assembly it is nevertheless possible to apply high forces to the coupling assembly. In a preferred embodiment, an axial bearing is arranged between the first pressure plate and the pressure disc. The load on said axial bearing is also reduced.

According to a preferred embodiment, it is proposed that the distance D1 between the outer edge of the disc spring and the intermediate diameter D3 is smaller than the distance D2 between the intermediate diameter D3 and the inner edge of the disc spring, more particularly, it is smaller by a multiple thereof. It is also proposed that the second pressure plate, on the intermediate diameter D3, comprises a formed on annular web which is in contact with the disc spring.

Furthermore, it is proposed that the disc spring, by means of its inner edge, freely rests against a radial face of the first pressure plate, with the disc spring, by means of its outer edge, being axially fixed between two securing rings secured in a coupling carrier.

The coupling assembly used is preferably a multi-plate coupling with a coupling carrier and a coupling hub, with the plates alternately being connected to the coupling carrier and to the coupling hub and with the plate package being supported on the coupling carrier.

A preferred embodiment of the invention is illustrated in the drawing.

The Figure shows half a longitudinal section through an inventive coupling assembly. The coupling assembly 11 comprises a coupling carrier 12 and a coupling hub 13 between which there is positioned a plate package 14. Outer coupling plates are connected to the coupling carrier 12 and inner coupling plates are connected to the coupling hub 13. The coupling assembly is axially loaded by an axial setting device 21 which comprises a supporting disc 23 supported in a housing 22, as well as a pressure disc 24 which is axially displaceable. The discs 23, 24 comprise circumferentially extending ball groves 25, 26 whose depth changes circumferentially in opposite directions. Between the pairs of ball grooves 25, 26 there are arranged balls 27 one of which can be seen in the Figure. Via a needle bearing 28, the pressure disc 24 is rotatably supported on the coupling hub 13. The supporting disc 23 is circumferentially held in the housing 22. The pressure disc 24 is rotatingly drivable via a spur gear drive 31 which comprises an intermediate shaft 32 with a double pinion 33, 34 and is drivable by a driving pinion 35. The pinion 35 is positioned on the output

shaft 36 of an electric motor 37. The bearing for the intermediate shaft is not shown. With the rotating drive being provided by the electric motor, the pressure disc 24 is rotated via the spur gear drive and axially pushes itself away from the supporting disc 23. The axial setting device 21 acts via an axial bearing 41 directly on a first pressure plate 42 which is contacted by the inner circumference of a disc spring 43. The outer circumference of the disc spring 43 is supported via two securing rings 44, 45 in the coupling carrier 12. In front of the plate package 14 there is positioned a second pressure plate 46 which, on an intermediate diameter D3, near the outer circumference, comprises an annular collar 47 which is contacted by the disc spring 43. When the first pressure spring 42 is axially displaced, the disc spring 43 secured in the coupling carrier 12 acts with a high lever effect on the annular collar 47 at the second pressure plate 46, so that with longer setting paths and lower forces at the first pressure plate 42, shorter setting paths and higher pressure forces occur at the second pressure plate 46. The ball ramp assembly 21 is thus freed from axial forces, i.e. more particularly, the forces at the axial bearing 41 and in the ball grooves 25, 26 are reduced considerably. The radial distance D1 between the outer edge of the disc spring and the annular collar is much smaller than the radial distance D2 between the annular collar and the inner edge of the disc spring.